RAMA UNIVERSITY

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DEPARTMENT OF BIOTECHNOLOGY
FACULTY OF ENGINEERING & TECHNOLOGY

LT.9. Gas Chromatography

Content Outline

TOPIC

•In this method stationary phase is a column which is placed in the device, and contains a liquid stationary phase which is adsorbed onto the surface of an inert solid. Gas chromatography is a "gas-liquid" chromatography. Its carrier phase consists of gases as He or N_2. Mobile phase which is an inert gas is passed through a column under high pressure.

•It exploits differences in the partition coefficients between a stationary liquid phase and a gas phase of the volatilised analytes as they are carried through the column by the mobile gas phase. Its use is therefore confined to analytes that are volatile but thermally stable.

•The partition coefficients are inversely proportional to the volatility of the analytes so that the most volatile elute first. The temperature of the column is raised to 50-300 ^{o}C to facilitate analyte volatilisation.

Types of GC

Two types of gas chromatography are encountered: gas-solid chromatography (GSC) and gas-liquid chromatography (GLC) depending upon column types.

GLC

• The stationary phase consists of a high-boiling-point liquid material such as silicone grease or wax that is either coated onto the internal wall of the column. It uses capillary column.

•Gas-liquid chromatography is useful for separating ions or molecules that are dissolved in a solvent. If the sample solution is in contact with a second solid or liquid phase, the different solutes will interact with the other phase to differing degrees due to differences in adsorption, ion-exchange, partitioning or size

•These differences allow the mixture components to be separated from each other by using these differences to determine the transit time of the solutes through a column

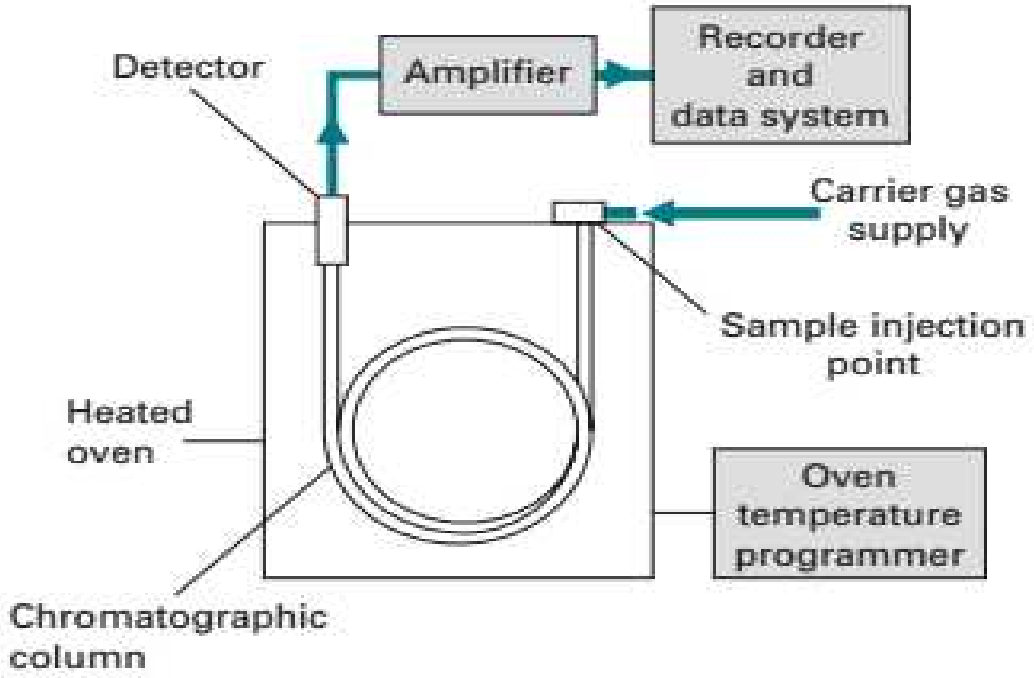
Gas Solid chromatography

Gas-solid chromatography is based upon a solid stationary phase on which retention of analytes is the consequence of physical adsorption. Gas–solid chromatography is used for a narrower range of separations than gas–liquid chromatography. Because of higher retention, typical applications are the separation of fixed gases, volatile hydrocarbons, halocarbons, organic solvents, and sulfur gases. The presence of immobilized active centers enhances the separation of isomers and isotopes. These separations are often difficult or impossible with liquid phases.

Components of GC

The major components of a GC system are:

- a column housed in an oven that can be temperature programmed;
- a sample inlet point;
- a carrier gas supply and control; and
- a detector, amplifier and data recorder system



Column

These are of two types: Packed conventional columns and Capillary (open tubular) columns .

Isothermal analysis: Here a constant temperature is employed.

Temperature programming: The temperature is gradually increased to facilitate the separation of compounds of widely differing polarity or Mr.

Detectors

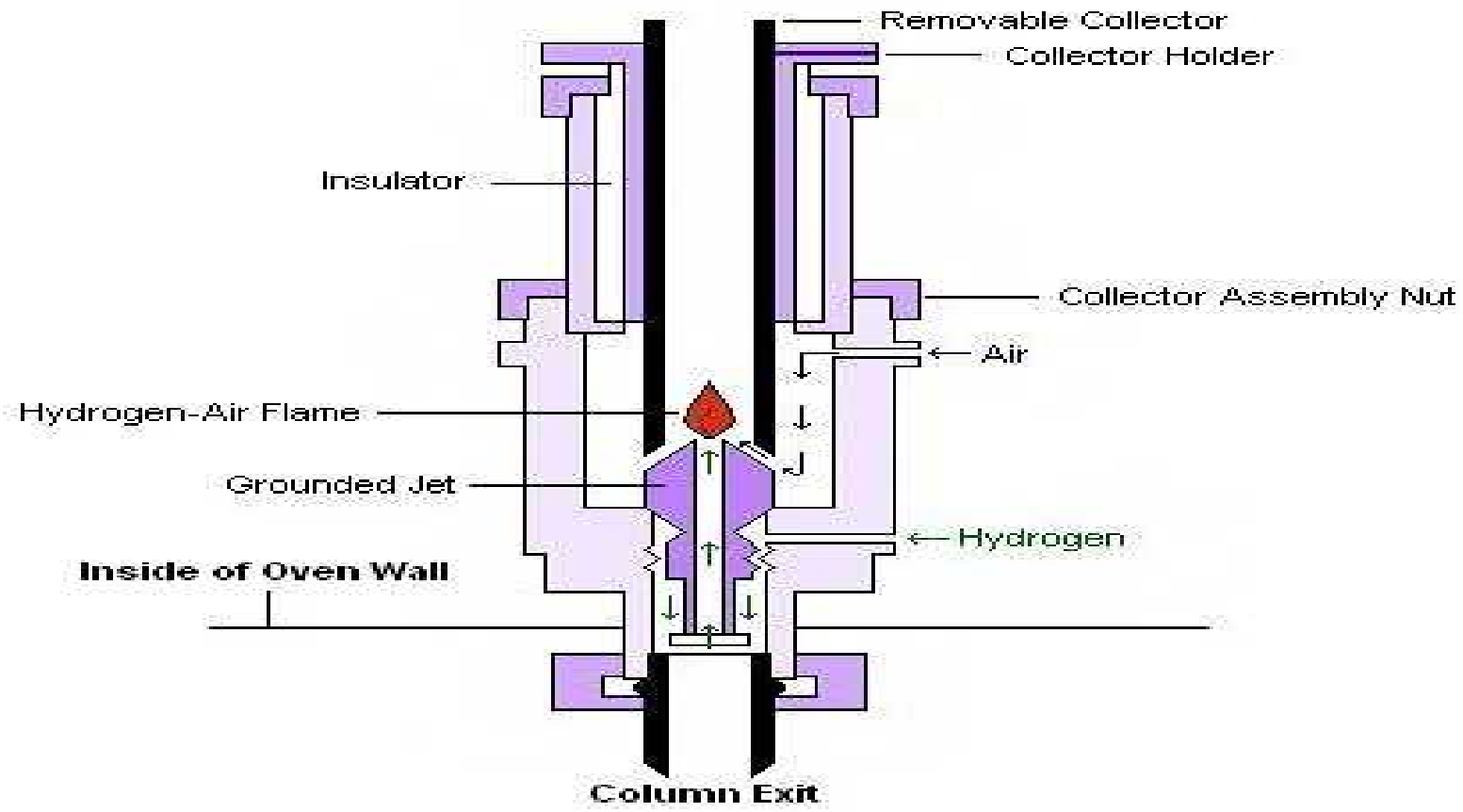
Flame Ionization Detectors

•Flame ionization detectors (FID) are the most generally applicable and most widely used detectors. In a FID, the sample is directed at an air-hydrogen flame after exiting the column. At the high temperature of the air-hydrogen flame, the sample undergoes pyrolysis, or chemical decomposition through intense heating. Pyrolized hydrocarbons release ions and electrons that carry current. A high-impedance picoammeter measures this current to monitor the sample's elution.

•It is advantageous to use FID because the detector is unaffected by flow rate, noncombustible gases and water. These properties allow FID high sensitivity and low noise. The unit is both reliable and relatively easy to use. However, this technique does require flammable gas and also destroys the sample.

$$\text{analyte} + H_2 + O_2 \longrightarrow \text{combustion products} + H_2O + \text{ions} + \text{radicals} + \text{electrons}$$

$$\sum(\text{ions})^- + \sum(\text{electrons})^- \longrightarrow \text{current}$$



Flame ionization

Electron-capture Detectors

Electron-capture detectors (ECD) are highly selective detectors commonly used for detecting environmental samples as the device selectively detects organic compounds with moieties such as halogens, peroxides, quinones and nitro groups and gives little to no response for all other compounds. Therefore, this method is best suited in applications where traces quantities of chemicals such as pesticides are to be detected and other chromatographic methods are unfeasible. This detector is widely used in the analysis of polychlorinated compounds, such as the pesticides DDT, dieldrin and aldrin.

Test your understanding

Gas chromatography can be performed in which of the following ways?

a. Only in columns
b. Only on plane surfaces
c. Either in columns or on plane surfaces
d. Neither in columns nor on plane surfaces

Gas chromatography is commonly used for separating Gas chromatography is commonly used for separating

a. Volatile compound
b. Non-Volatile compound
c. Malleable metals
d. none of the above

In gas chromatography, the basis for separation of the components of the volatile material is the difference in

a. conductivity
b. partition coefficients
c. molecular weight
d. molarity

Gas- Liquid chromatography essential consists of

a. stationary phase having high-boiling-point liquid material
b. stationary phase having low-boiling-point liquid material
c. solid stationary phase material
d. None of the above

References & Further reading

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3. Biochemical Methods of Analysis, Saroj Dua And Neera Garg : Narosa Publishing House, New Delhi.
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